

What is claimed is:

1. A method for measuring a patterned structure (3) comprising:

exciting the structure (3) by irradiating it with a spatially periodic laser intensity pattern in order to generate surface acoustic waves.

diffracting a probe laser beam (6) off the thermal grating to form a signal beam;

detecting the signal beam as a function of time to generate a signal waveform; and

determining at least one property of the patterned structure based on the effect of the surface profile on surface acoustic wave phase velocity.

2. The method of Claim 1, wherein the exciting step further comprises a spatially periodic laser intensity pattern having a period ranging from 1 to 20 microns.

3. The method of Claim 1, wherein the patterned structure is comprised of trenches equal to or less than approximately 2  $\mu\text{m}$  in width.

4. The method of Claim 3, wherein the patterned structure further comprises a periodic array of trenches.

5. The method of Claim 4, wherein the patterned structure further comprises a periodic array of linear trenches.
6. The method of Claim 4, wherein the patterned structure further comprises a two-dimensional periodic array of trenches.
7. The method of Claim 4, wherein the trenches are fabricated in a silicon substrate.
8. The method of Claim 3, wherein the trenches are fabricated in a thin film.
9. The method of Claim 1, wherein the at least one property comprises trench depth.
10. The method of Claim 1, wherein the at least one property comprises trench width.
11. The method of Claim 1, wherein the at least one property comprises a depth profile of the trench structure.
12. The method of Claim 1, wherein the determining step further comprises combining measurements at multiple acoustic

wavelengths to determine multiple parameters of the trench structure.

13. The method of Claim 5, wherein the determining step further comprises combining measurements along and across the trench structure to determine both trench depth and width.

14. The method of Claim 1, wherein the determining step further comprises combining measurements within and outside the patterned area to separate the effect on the surface acoustic wave velocity caused by the trench structure from the other effects such as film thickness.

15. The method of claim 1, wherein the determining step comprises analysis of the signal waveform with a theoretical model based on elastic properties of the structure.

16. The method of Claim 1, wherein the determining step comprises analysis of the signal waveform with a model based on an empirical calibration.